APPENDIX E: AIR QUALITY

E.1 NONRADIOLOGICAL AIR QUALITY

This appendix supplements the analytical results in the Y-12 Site-Wide Environmental Impact Statement (SWEIS) main text. Modeling inputs and assumptions support the results presented in the nonradiological air quality section of Chapter 5, Environmental Consequences. Site-specific emissions from Y-12 are modeled in accordance with the guidelines presented in the U.S. Environmental Protection Agency (EPA) Guideline Air Quality Models (40 CFR 51).

The primary emission source of criteria pollutants at Y-12 is the Steam Plant (Building 9401-3). Impacts are estimated from criteria pollutant emissions associated with the No Action - Status Quo Alternative using the calculated heat input capacity of the Y-12 Steam Plant. The maximum criteria pollutant concentrations from operation of the Y-12 Steam Plant are calculated at boundary receptors. Modeling inputs include emission rates for the Y-12 Steam Plant operating at the calculated heat input capacity, 5 years of meteorological data (1992–1996), and receptors located at 100-m (328-ft) intervals on the Y-12 site boundary. The resulting criteria pollutant concentrations are compared to National Ambient Air Quality Standards (NAAQS) (40 CFR 50) and Tennessee Department of Environment and Conservation (TDEC) regulations (TDEC 1999).

Impacts from hazardous air pollutants (HAPs) resulting from the combustion of coal and Y-12 facility operations are estimated by comparison of the chemical emission rates with a Threshold Emission Value (TEV) based upon "industry-recognized" guidelines. The guidelines are as follows:

- American Conference of Governmental Industrial Hygienists (ACGIH) (threshold limit values [TLVs]), (ACGIH 1997)
- Occupational Safety and Health Administration (OSHA) (permissible exposure limits [PELs]), (ACGIH 1997)
- National Institute for Occupational Safety and Health (NIOSH) (recommended exposure limits [RELs]), (ACGIH 1997)
- Deutsche Forschungsgemeinschaft, Federal Republic of Germany, Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area (ACGIH 1997)

These sources provide guideline upper values or (for OSHA standards) enforceable limits of pollutant concentrations to which workers at their job sites (health workers) may be exposed over an 8-hour day during their working years.

E.2 CRITERIA POLLUTANTS

Air Quality Dispersion Model

The EPA Industrial Source Complex (ISC3) air quality dispersion model was used to estimate the criteria pollutant concentrations from the Y-12 Steam Plant. This model was selected as the most appropriate model to perform the air dispersion modeling analysis from continuous emission sources because it is designed to support the EPA regulatory modeling program and is capable of handling multiple sources, including different source types. This model was also used to estimate hazardous air pollutant concentrations from Y-12 facility emissions.

The criteria pollutants modeled using ISC3 include carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxide (NO_x), and particulate matter equal to or less than 10 microns in diameter (PM_{10}). Concentrations of lead

and ozone were provided from monitoring data where available.
The estimated emission rates for the Y-12 Steam Plant are based upon actual fuel consumption for February 6, 1996, the coldest day in the last five years at Y-12 (according to local meteorological data). The Y-12 Steam Plant boilers are fired either by coal or by natural gas. Each boiler has a capacity of approximately 95,256 kg/hr (210,000 lb/hr) of steam. A coal pile and coal handling system are also part of the Y-12 Steam Plant. The coal handling system consists of a hopper feeder, a crusher, and conveyor belts. Each boiler is equipped with two pulverizing mills. The flue gas from each boiler is ducted through an air preheater. Flue gas then passes through a reverse air baghouse. The heat from combustion of fuel and flow of hot gases across water-filled tubes in the boiler produces steam. The combustion converts fuel to heat energy to change the boiler water to steam (LMES 1997).

Criteria pollutant emissions from the Y-12 Steam Plant were calculated using the heat input capacity of 522 Mbtu/hr for the facility, based on actual fuel usage on February 6, 1996. If the Y-12 Steam Plant were to operate at this heat capacity using coal as the fuel source for an entire year (8,760 hours), then coal usage is calculated to be 190,530 tons (381 million lb). If natural gas is used as the fuel source for an entire year, 5.6 million m^3 (199 million ft^3)of natural gas is burned. Actual fuel usage for 1996 was 93,240 tons (186 million lb) of coal and 977 million m^3 (34,493 million ft^3) of natural gas. Table E.2-1 presents the emission factors and calculated emission rates based upon the Y-12 Steam Plant operating at the calculated heat input capacity of 522 Mbtu/hr.

The emission rates presented in the table represent the maximum daily Y-12 Steam Plant operation for the last five years. These emission rates are considered a reasonable upper bound for operation of the facility for the purpose of estimating maximum criteria pollutant concentrations from operations at Y-12.

The concentrations highlighted in gray-scale in Table E.2–2 are the maximum modeled concentrations resulting from the five years of meteorological data (1992-1996). These concentrations were scaled according to the actual emissions to obtain the maximum pollutant concentrations at the Y-12 Site boundary based upon the emission rates presented in Table E.2–1.

Source Parameters

Source parameters for each of the two Y-12 Steam Plant stacks were obtained from the Title V permit application, *Major Source Operating Permit Applications for the U.S. Department of Energy Oak Ridge, Y-12 Plant* (LMES 1994). The two stacks were treated as a single source for modeling purposes, each located at the same Universal Transverse Mercator (UTM) coordinates, but retaining their respective physical characteristics. Table E.2–3 presents the Y-12 stack parameters used as modeling input.

Receptors

Receptors used for modeling the Y-12 Steam Plant include 211 discrete receptors located at 100-m (328-ft) intervals along the Y-12 Site boundary. Elevations provided for each of the 211 discrete receptors allowed the ISC3 model to calculate concentrations at receptors on elevated terrain. Figure E.2-1 presents the Y-12 Plant boundary for purposes of this SWEIS.

TABLE E.2–1.—*Y-12 Steam Plant Emission Rates and Emission Factors for Criteria Pollutant Emissions*

Source	Fuel	Fuel Usage (tons/day)	UnitCapacity (MBtu/hr)	Carbon Monoxide		Nitrogen Dioxide		Sulfur Dioxide		Particulate Matter		VOC	
				EF (lb/ton)	ER (g/sec)	EF (lb/ton)	ER (g/sec)	EF (lb/ton)	ER (g/sec)	EF (lb/ton)	ER (g/sec)	EF (lb/ton)	ER (g/sec)
Boilers 1- 4	Coal	522	522	0.5	1.37	34	93.17	38S	215.56	7A	1.81	0.04	0.11

Source	Fuel	Fuel Usage (MCF/day)	UnitCapacity (MBtu/hr)	Carbon Monoxide		Nitrogen Dioxide		Sulfur Dioxide		Particulate Matter		VOC	
				EF (lb/MCF)	ER (g/sec)	EF (lb/MCF)	ER (g/sec)	EF (lb/MCF)	ER (g/sec)	EF (lb/MCF)	ER (g/sec)	EF (lb/MCF)	ER (g/sec)
Boilers 1- 4	Natural Gas	0.545	24	40	0.114	550	1.57	0.6	0.00172	5	0.000143	1.7	0.25

Source	Fuel	UnitCapacity (Mbtu/hr)	Carbon Monoxide ER (g/sec)	Nitrogen Dioxide ER (g/sec)	Sulfur Dioxide ER (g/sec)	Particulate Matter ER (g/sec)	VOC ER (g/sec)
Boilers 1- 4	Coal & Natural Gas	546	1.484	94.74	215.56	1.81	0.115

Note: EF = Emission Factor; ER = Emission Rate.
Sulfur content of coal (2.07 percent).
Ash content of coal (9.45 percent).
Heating value: coal = 12,000 Btu/lb; natural gas = 1050 Btu/ft³.
Baghouse efficiency = 99 percent.
Source: EPA 1995.

Meteorological Data

Sequential hourly meteorological data from the 60-m (197-ft) level from tower MT6, located in the western portion of Y-12, for the five-year period (1992 - 1996) were used as model input. The meteorological data include flow vector, wind speed, ambient temperature, stability class, and mixing height. The meteorological data at the 60-m (197-ft) level were used since this level closely matches the height of the Y-12 Steam Plant stacks, which are 58-m (190-ft) tall. Figure E.2–2 presents the annual wind roses for tower MT6 for each of the five years of meteorological data. In addition, upper air data from the National Weather Service Station 13897 located at Nashville, TN, were used to generate hourly mixing height data used as input to the EPA model ISC3.

Table E.2–2.—*Y-12 Steam Plant Maximum Modeled Concentrations for a 1 Gram per Second Emission Rate*

Averaging Time	Maximum Y-12 Boundary Concentrations (Fg/m^3)				
	1992	**1993**	**1994**	**1995**	**1996**
1 Hour	2.66	2.76	2.68	2.72	2.90
3 Hours	2.43	2.14	2.32	2.03	1.95
8 Hours	1.67	1.31	1.70	1.50	1.46
24 Hours	0.81	0.71	0.64	0.79	0.76
Annual	0.091	0.081	0.096	0.088	0.086

TABLE E.2–3.—*Y-12 Steam Plant (Building 9401-3) Source Parameters*

Stack	Stack Height (m)	Stack Diameter (m)	Exit Velocity (m/s)	Exit Temperature (K)	UTM-E[a] (m)	UTM-W[a] (m)	Base Elevation (m)
West	57.9	3.81	8.84	427.6	746,909.25	3,985,445.25	294.132
East	57.9	4.572	6.096	427.6	746,909.25	3,985,445.25	294.132

[a] UTM-E - Universal Transverse Mercator East coordinates.
[b] UTM-W - Universal Transverse Mercator West coordinates.
Source: LMES 1997.

Model Assumptions

Model assumptions included using the regulatory default options that are identified in Appendix A of the *Guideline on Air Quality Models* (Revised) (40 CFR 51):

- Final plume rise
- Stack-tip downwash
- Buoyancy-induced dispersion
- Calms processing routine
- Missing data processing routine
- Default wind speed profile exponents
- Default vertical potential temperature gradients
- Rural dispersion
- Receptors on elevated terrain
- Complex terrain

Source: DOE 1999.

FIGURE E.2–1.—*The Y-12 Site-Wide Environmental Impact Statement Area of Analysis.*

Source: Computer Modeling Results.

FIGURE E.2–2.—*Annual Wind Rose Data for Tower MT6 at Y-12.*

For modeling purposes it is assumed that the Y-12 Steam Plant operates 8,760 hours per year during a non-leap year and 8,784 hours per year during a leap year.

E.3 CHEMICAL POLLUTANTS

The objective of the chemical pollutant screening is to determine those routine chemical emissions (those occurring daily from ongoing normal operations at Y-12) which may pose a potential risk to human health. Title III of the 1990 *Clean Air Act* (CAA) Amendments addresses the emissions of 189 HAPs and mandates that EPA develop technology-based (Maximum Achievable Control Technology [MACT]) standards for the control of these pollutants from approximately 174 source categories. After implementation of MACT standards, EPA is required to further evaluate "residual risk" from HAP emissions and, if required, develop more stringent standards to protect human health and the environment with an "adequate margin of safety."

A screening was performed to select only those chemicals that, due to the quantity of emissions or the toxicity of the chemical, may be chemicals of concern. Those chemicals that exceed the screening criteria were then further evaluated in the Human Health and Worker Safety analysis of this SWEIS (Appendix D) to determine potential human health risks.

The chemicals were categorized into two groups, noncarcinogenic chemicals and carcinogenic chemicals, to address the differences in health effects. Each group was evaluated using a screening technique comparing each chemical's estimated emission rate to a health risk-based TEV. Current dose-to-risk conversion factors and the "best available technology" were used in assessing impacts to human health (Appendix D). Consistent with the human health impacts assessment methodology, appropriate health risk values were used in the chemical screening process to derive chemical-specific TEVs. Because of the different health effects (noncarcinogenic and carcinogenic), two methods were applied to derive chemical-specific TEVs.

The combustion of coal at the Y-12 Steam Plant produces emissions of noncarcinogenic and carcinogenic HAPs as well as criteria pollutants. Calculated emission rates are based upon operation of the Y-12 Steam Plant at the rated heat input capacity of 522 MBtu/hr, AP-42 emission factors for pulverized coal boilers (uncontrolled HAP emissions), and baghouse efficiency at 99 percent (except for mercury, which assumed no emission controls) (LMES 1997). Table E.3–1 presents AP-42 emission factors for HAP emissions from the Y-12 Steam Plant. The Steam Plant is assumed to operate 8,760 hours per year at the rated heat input capacity.

TABLE E.3–1.—*Emission Factors for HAP Emissions from the Y-12 Steam Plant*

Pollutant	Emission Factor ($lb/1 \times 10^{12}$ Btu)
Arsenic	538
Beryllium	81
Cadmium	44-70
Chromium	1020-1570
Lead	507
Manganese	808-2980
Mercury	16
Nickel	840-1290

Source: EPA 1995.

E.3.1 Noncarcinogenic Chemical Screening

The screening analysis for noncarcinogenic chemicals uses the four "industry-recognized" guidelines (ACGIH 1997) to determine the most conservative guideline concentration applicable to each chemical. The minimum guideline concentration from those references (henceforth referred to as the Occupational Exposure Limit [OEL]), divided by 100 (a conservative margin of safety for identifying those chemicals of potential public concern) was used as the screening criterion for the noncarcinogenic chemicals. Each screening criterion divided by the maximum 8-hour concentration at the site boundary from modeling a 1 gram per second emission rate results in the TEV. The TEV represents the emission rate that would result in an 8-hour chemical concentration equal to the screening guideline (i.e., OEL/100). The maximum annual and 8-hour concentration at the site boundary was calculated using the ISC3 model and the input parameters described in Table E.2–3 for Y-12 Steam Plant emissions and Table E.3.1–1 for Y-12 Site emissions.

TABLE E.3.1–1.—*Source Parameters for Centrally Located Stack at Y-12 Site*

Stack	Stack Height (m)	Stack Diameter (m)	Exit Velocity (m/s)	Exit Temperature (K)	UTM-E[a] (m)	UTM-W[b] (m)	Base Elevation (m)
Central Stack	10	0.3048	0.50	293.0	747120.8278	3985944.6028	286.000

[a] UTM-E - Universal Transverse Mercator East coordinates.
[b] UTM-W - Universal Transverse Mercator West coordinates.
Source: LMES 1997.

Noncarcinogenic Chemical Screening -Y-12 Steam Plant Operations

The noncarcinogenic HAP emission rates for the Y-12 Steam Plant were compared with the respective TEVs. If the HAP emission rates for the Y-12 Steam Plant were greater than the respective TEV, then the chemical concentration resulting from the Y-12 Steam Plant HAP emission was considered a chemical of concern. If the HAP emission rate was less than the TEV, then the chemical was not considered a chemical of concern and therefore, not a threat to human health. Table E.3.1–2 presents the screening results for the Y-12 Steam Plant noncarcinogenic HAP emissions.

TABLE E.3.1–2.—*Y-12 Steam Plant Noncarcinogenic Hazardous Air Pollutant Emissions*

Building Number	CAS Number	Chemical	Emissions (gms/yr)	Emission Rate (gms/sec)	OEL/100 (Fg/m^3)	TEV (gms/sec)	Result
Y-9401-3	7440-47-3	Chromium	3.26×10^4	1.03×10^{-3}	5	2.94	FALSE
Y-9401-3	7439-92-1	Lead	1.05×10^4	3.33×10^{-4}	0.5	0.294	FALSE
Y-9401-3	7439-96-5	Manganese	6.18×10^5	1.96×10^{-3}	2.00×10^{-2}	1.18×10^{-2}	FALSE
Y-9401-3	7439-97-6	Mercury	3.32×10^4	1.05×10^{-3}	0.25	0.147	FALSE

Source: LMES 1997, ACGIH 1997.

The FALSE in the result column in the table indicates that none of the noncarcinogenic HAP emissions from the Y-12 Steam Plant exceeded the TEV and therefore, are not considered chemicals of concern.

Noncarcinogenic Chemical Screening - Y-12 Site Operations

Noncarcinogenic chemical emissions from Y-12 Site operations were evaluated using the same screening criteria as that used for the Y-12 Steam Plant noncarcinogenic chemical emissions. An annual chemical concentration was calculated for the site boundary while an 8-hour concentration was calculated for evaluation of impacts to the on-site worker. A 1 gram per second emission rate was modeled from a stack located centrally within the Y-12 Site complex of facilities. Table E.3.1–1 presents the stack parameters used in the modeling analysis of Y-12 Site operations.

Chemical emissions from Y-12 Site operations were not available since there are no regulations requiring an emissions inventory. Therefore, to estimate chemical emissions from Y-12 Site facilities, an inventory of purchased chemicals during 1998, representing 189 HAPs identified by EPA, was obtained from the 1998 Lockheed Martin Energy Systems, Inc. (LMES), Hazardous Material Information System (MMES 1998) transaction data summaries. Pure chemical HAP quantities as well as HAP ingredients contained within purchased chemicals are included in the total quantities for each HAP. Quantities of HAPs containing metals as solids were deleted from consideration since there is little chance for emission of solids.

Chemical emission rates for each noncarcinogenic chemical were calculated by dividing the 1998 purchased amount in grams by 2,000 hours (converted to seconds, to obtain an emission rate in grams per second). The 2,000 hours represent a 40-hour work week multiplied by 50 work weeks per year as the number of hours during which the chemicals are emitted. Using 2,000 hours per year results in a conservative emission rate since some facilities actually emit for 16 or 24 hours per day for 260 days per year (LMES 1997). Also for conservative reasons it was assumed that 100 percent of the purchased chemicals are released to the atmosphere from the facilities. Modeling options for ISC3 were selected such that concentrations are calculated on a Monday to Friday, 8-hour workday basis only.

Sequential hourly meteorological data from the 10-m (33-ft) level from tower MT6 located in the western portion of Y-12 for the five-year period (1992 -1996) were used as model input. These meteorological data were used since the 10-m (33-ft) level closely matches the release heights of the Y-12 process facilities. In addition, upper air data from the National Weather Service Station 13897 located at Nashville, TN were used to generate hourly mixing height data used as input to the EPA model ISC3. The results of the modeling are presented in Table E.3.1–3.

TABLE E.3.1–3.—*Maximum Modeled Concentrations from a Centrally Located Stack at Y-12 for a 1 Gram per Second Emission Rate*

Averaging Time	Maximum Y-12 Boundary Concentration (Fg/m^{3})				
	1992	**1993**	**1994**	**1995**	**1996**
8-Hour	21.81	36.74	45.10	19.21	27.62
Annual	0.37	0.39	0.31	0.28	0.28
Averaging Time	**Maximum On-Site Concentration (Fg/m^{3})**				
	1992	**1993**	**1994**	**1995**	**1996**
8-Hour	646.45	540.94	693.53	679.77	689.80
Annual	39.99	38.36	34.95	35.92	38.68

Source: Modeling results.

TABLE E.3.1–4.—*Screening Evaluation of Noncarcinogenic Chemical Emissions from the Y-12 Site* [Page 1 of 4]

CAS Number	Chemical	Total Kilograms	Emissions (g/yr)	ER (g/s)	OEL (mg/m^3)	OEL/100 (Fg/m^3)	TEV (g/s)	Result
00071-55-6	1,1,1-Trichloroethane[a]	44500	4.45×10^{7}	6.18	1080	1.08×10^{4}	2.39×10^{2}	FALSE
000120-82-1	1,2,4-Trichlorobenzene	0.0028	2.80	3.89×10^{-7}	No OEL			
000106-88-7	1,2-Butylene Oxide	3.0915	3.09×10^{3}	4.29×10^{-4}	No OEL			
000096-12-8	1,2-Dibromo-3-Chloropropane	0.4535	$4.54 \times 10^{+02}$	6.30×10^{-05}	No OEL			
000123-91-1	1,4-Dioxane	5.2329	5.23×10^{3}	7.27×10^{-4}	72	7.20×10^{2}	16.0	FALSE
000095-95-4	2,4,5-Trichlorophenol	0.005	5.00	6.94×10^{-7}	No OEL			
000094-75-7	2,4-D	0.0299	29.9	4.15×10^{-6}	1	10.0	0.22	FALSE
000121-14-2	2,4-Dinitrotoluene	0.0272	27.2	3.78×10^{-6}	No OEL			
000091-94-1	3,3-Dichlorobenzidine	0.0002	0.20	2.78×10^{-08}	No OEL			
00067-64-1	Acetone[a]	800	8.00×10^{5}	0.11	590	5.90×10^{3}	1.31×10^{2}	FALSE
000075-05-8	Acetonitrile	339.734	3.40×10^{5}	4.72×10^{-2}	34	3.40×10^{2}	7.54	FALSE
000107-02-8	Acrolein	0.0159	15.9	2.21×10^{-6}	0.23	2.30	5.10×10^{-2}	FALSE
000079-10-7	Acrylic Acid	0.0441	44.1	6.13×10^{-6}	5.9	59.0	1.31	FALSE
007647-01-0	Ammonia[a]	870	8.70×10^{5}	0.12	14	1.40×10^{2}	3.10	FALSE
000062-53-3	Aniline	0.0049	4.90	6.81×10^{-7}	7.6	76.0	1.69	FALSE
007440-36-0	Antimony & Compounds	11.3562	1.14×10^{4}	1.58×10^{-3}	0.5	5.00	0.11	FALSE
000156-62-7	Calcium Cyanamide	0.0999	99.9	1.39×10^{-5}	0.5	5.00	0.11	FALSE
000075-15-0	Carbon Disulfide	4.2912	4.29×10^{3}	5.96×10^{-4}	3	30.0	0.67	FALSE
000108-90-7	Chlorobenzene	0.0999	99.9	1.39×10^{-5}	46	4.60×10^{2}	10.2	FALSE

TABLE E.3.1–4.—*Screening Evaluation of Noncarcinogenic Chemical Emissions from the Y-12 Site* [Page 2 of 4]

CAS Number	Chemical	Total Kilograms	Emissions (g/yr)	ER (g/s)	OEL (mg/m³)	OEL/100 (Fg/m³)	TEV (g/s)	Result
000126-99-8	Chloroprene	0.3778	3.78×10^{2}	5.25×10^{-5}	18	1.80×10^{2}	3.99	FALSE
007440-48-4	Cobalt & Compounds	610.6878	6.11×10^{5}	8.48×10^{-2}	0.02	0.20	4.43×10^{-3}	TRUE
000057-12-5	Cyanide & Compounds	5.7417	5.74×10^{3}	7.97×10^{-4}	5	50.0	1.11	FALSE
000111-42-2	Diethanolamine	8.9172	8.92×10^{3}	1.24×10^{-3}	2	20.0	0.44	FALSE
000100-41-4	Ethylbenzene	1299.8033	1.30×10^{6}	0.18	434	4.34×10^{3}	96.6	FALSE
000075-00-3	Ethyl Chloride	0.0928	92.8	1.29×10^{-5}	264	2.64×10^{3}	58.5	FALSE
000107-21-1	Ethylene Glycol	4226.3023	4.23×10^{6}	0.59	26	2.60×10^{2}	5.76	FALSE
000096-45-7	Ethylene Thiourea	0.0104	10.4	1.44×10^{-6}	No OEL			
	Glycol Ethers	6411.5776	6.41×10^{6}	89.0				
000110-54-3	Hexane	41.8665	4.19×10^{4}	5.81×10^{-3}	176	1.76×10^{3}	39.0	FALSE
007647-01-0	Hydrochloric Acid (aerosol)[b]	1337.7	1.34×10^{6}	0.18	7	70.0	1.55	FALSE
007664-39-3	Hydrofluoric Acid	70.8546	7.09×10^{4}	9.84×10^{-3}	2	20.0	0.44	FALSE
000123-31-9	Hydroquinone	4.7944	4.79×10^{3}	6.66×10^{-4}	2	20.0	0.44	FALSE
000540-84-1	Isooctane	14.4923	1.45×10^{4}	2.01×10^{-3}	No OEL			
007439-92-1	Lead Compounds[c]	633	6.33×10^{5}	8.79×10^{-2}	0.05	0.50	1.11×10^{-2}	TRUE
000058-89-9	Lindane	1.8143	1.81×10^{3}	2.52×10^{-4}	0.5	5.00	0.11	FALSE
007439-97-6	Mercury	367.3306	3.67×10^{5}	5.10×10^{-2}	0.025	0.25	5.54×10^{-3}	TRUE
000067-56-1	Methanol	20833.4148	2.08×10^{7}	2.89	260	2.60×10^{3}	57.6	FALSE
000071-55-6	Methyl Chloroform	210.2718	2.10×10^{5}	2.92×10^{-2}	1080	1.08×10^{4}	2.39×10^{2}	FALSE
000078-93-3	Methyl Ethyl Ketone	65.7404	6.57×10^{4}	9.13×10^{-3}	590	5.90×10^{3}	1.31×10^{2}	FALSE

TABLE E.3.1–4.—*Screening Evaluation of Noncarcinogenic Chemical Emissions from the Y-12 Site* [Page 3 of 4]

CAS Number	Chemical	Total Kilograms	Emissions (g/yr)	ER (g/s)	OEL (mg/m^3)	OEL/100 (Fg/m^3)	TEV (g/s)	Result
000108-10-1	Methyl Isobutyl Ketone	19.3795	1.94×10^{4}	2.69×10^{-3}	82	8.20×10^{2}	18.2	FALSE
000080-62-6	Methyl Methacrylate	9.1898	9.19×10^{3}	1.28×10^{-3}	210	2.10×10^{3}	46.6	FALSE
000101-68-8	Methylene Bisphenyl Isocyanate	1813.2026	1.81×10^{6}	0.25	0.05	0.50	1.11×10^{-2}	TRUE
000075-09-2	Methylene Chloride	1840.4272	1.84×10^{6}	2.56×10^{-1}	174	1.74×10^{3}	38.6	FALSE
000084-74-2	N-butyl Phthalate	3.364	3.36×10^{3}	4.67×10^{-4}	5	50.0	1.11	FALSE
007697-37-2	Nitric Acid[c]	246	2.46×10^{5}	3.42×10^{-2}	5	50.0	1.11	FALSE
000098-95-3	Nitrobenzene	0.0572	57.2	7.94×10^{-6}	5	50.0	1.11	FALSE
000095-48-7	O-cresol	0.4082	4.08×10^{2}	5.67×10^{-5}	No OEL			
000106-46-7	P-dichlorobenzene	16.8102	1.68×10^{4}	2.33×10^{-3}	60	6.00×10^{2}	13.3	FALSE
000106-42-3	P-xylene	5.6891	5.69×10^{3}	7.90×10^{-4}	434	4.34×10^{3}	96.2	FALSE
000087-86-5	Pentachlorophenol	0.005	5.00	6.94×10^{-7}	0.5	5.00	0.11	FALSE
000127-18-4	Perchloroethylene[a]	31200	3.12×10^{7}	4.33	170	1.70×10^{3}	37.7	FALSE
000108-95-2	Phenol	6.354	6.35×10^{3}	8.83×10^{-4}	19	1.90×10^{2}	4.21	FALSE
007723-14-0	Phosphorus (Red or Black)	0.7795	7.80×10^{2}	1.08×10^{-4}	0.1	1.00	2.22×10^{-2}	FALSE
000100-42-5	Styrene	0.0513	51.3	7.13×10^{-6}	85	8.50×10^{2}	18.8	FALSE
001634-04-4	Tert-butyl Methyl Ether	0.038	38.0	5.28×10^{-6}	144	1.44×10^{3}	31.9	FALSE
000127-18-4	Tetrachloroethylene	17.235	1.72×10^{4}	2.39×10^{-3}	170	1.70×10^{3}	37.7	FALSE
000108-88-3	Toluene	7400.2662	7.40×10^{6}	1.03	188	1.88×10^{3}	41.7	FALSE
000079-01-6	Trichloroethylene	6.701	6.70×10^{3}	9.31×10^{-4}	269	2.69×10^{3}	59.6	FALSE

TABLE E.3.1–4.—*Screening Evaluation of Noncarcinogenic Chemical Emissions from the Y-12 Site* [Page 4 of 4]

CAS Number	Chemical	Total Kilograms	Emissions (g/yr)	ER (g/s)	OEL (mg/m^3)	OEL/100 ($\mu g/m^3$)	TEV (g/s)	Result
000108-05-4	Vinyl Acetate	13.5963	1.36×10^{4}	1.89×10^{-3}	35	3.50×10^{2}	7.76	FALSE
000075-01-4	Vinyl Chloride	0.0054	5.40	7.50×10^{-7}	13	1.30×10^{2}	2.88	FALSE
001330-20-7	Xylene	7376.8969	7.38×10^{6}	1.02	434	4.34×10^{3}	96.2	FALSE

[a] Shelton 1999, Smith 1999.
[b] Assumes 3 percent emission rate of purchases.
[c] DOE 1999.
Note: CAS - Chemical Abstracts Service Registry Number; ER - Emission Rate; OEL - A time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect; TRUE - Emission rate exceeds the TEV; FALSE - Emission rate is less than the TEV.
Source: MMES, 1998, ACGIH 1997.

TABLE E.3.1–5.—*Maximum Boundary and On-site Noncarcinogenic Chemical Concentrations from Y-12 Site Operations*

CAS Number	Chemical	Total Kilograms	Emissions (g/yr)	ER (g/s)	Maximum Boundary Concentration [a] (Fg/m^3)	Maximum On-site Concentration[b] (Fg/m^3)
007440-48-4	Cobalt & Compounds	610.6878	$6.11 \times 10^{+5}$	8.48×10^{-2}	3.31×10^{-2}	58.8
007439-92-1	Lead Compounds	633	$6.33 \times 10^{+5}$	8.79×10^{-2}	3.43×10^{-2}	61.0
007439-97-6	Mercury	367.3306	$3.67 \times 10^{+5}$	5.10×10^{-2}	1.99×10^{-2}	35.4
000101-68-8	Methylene Bisphenyl Isocyanate	1813.2026	$1.81 \times 10^{+6}$	2.52×10^{-1}	9.82×10^{-2}	$1.75 \times 10^{+2}$

[a] Annual average concentrations.
[b] 8-hour average concentration.
Note: CAS - Chemical Abstracts Service Registry Number; ER - Emission Rate.
Source: MMES 1998, ACGIH 1997.

A total of 57 noncarcinogenic HAPs were identified from the Hazardous Material Information System (MMES 1998). These HAPs are presented in Table E.3.1–4 along with emission rates, OEL screening criteria, and TEV. No OEL is available for nine of the HAPs. The maximum quantity for those HAPs with no OEL is 14.4923 kg (32 lb), which results in an emission rate of 2.01×10^{-3} grams per second, an emission rate that is of concern for only the most highly toxic chemical. The fact that these HAPs have no OEL means that the HAP is likely to meet one or more of the following conditions:

- It is not used routinely.
- It is not present or used in regulated quantities.
- It is controlled according to general OSHA requirements (personal protective equipment, labeling, Material Safety Data Sheet recommendations, etc.).
- It is not designated for regulation (based on interagency regulatory committee determination).
- It is determined nontoxic to the environment or human health.
- It is used for research and development or market research only.

Only four noncarcinogenic HAPs exceeded the screening criteria. Table E.3.1–5 presents maximum annual site boundary and on-site maximum 8-hour concentrations representing exposure to the general public and on-site work, respectively, for those HAPs that exceed the screening criteria.

E.3.2 Carcinogenic Chemical Screening

Those carcinogenic chemicals released from the Y-12 Steam Plant from burning coal and from Y-12 Site operations were screened according to the criteria described below.

For each chemical, a concentration was calculated representing a cancer risk of 1.0×10^{-8} for an exposed individual. This number represents an incremental cancer risk of 1.0×10^{-6} (e.g., one person in one million would develop cancer if exposed to this concentration over a lifetime). This level of concern is established in the CAA (42 U.S.C. §7401). For the purposes of screening, the 1.0 x 10^{-6} cancer risk was divided by 100 as a conservative margin of safety, thereby establishing 1.0 x 10^{-8} as the cancer risk screening level.

The calculated concentration representing a cancer risk of 1.0 x 10^{-8} for an exposed individual at the site boundary was divided by the maximum annual average concentration obtained from modeling a 1 gram per second emission rate. The annual average concentration is used since the 1.0 x 10^{-8} risk level represents a long-term exposure risk to an individual. The result is the TEV, an emission rate that results in a concentration with a cancer risk of 1.0 x 10^{-8}, a chemical concentration below which no health effect is expected. The TEV was compared to the calculated emission rate. If the calculated emission rate was greater than the respective TEV, then the chemical concentration resulting from the carcinogenic chemical emissions is considered a chemical of concern. If the calculated emission rate was less than the TEV, then the chemical was not considered a chemical of concern and therefore, no a potential threat to human health.

The unit risk factors, defined in terms of risk per exposure to a unit concentration of chemical (risk/Fg/m^3), used to calculate the concentration at the 10^{-8} risk level were obtained from the EPA Integrated Risk Information System (IRIS) (EPA 1999) estimate of carcinogenic risk from inhalation exposure. Only those HAPs for which unit risk factors are available were categorized as carcinogenic HAPs.

Carcinogenic Chemical Screening - Y-12 Steam Plant Operations

The results of the carcinogenic screening analysis for the Y-12 Steam Plant are presented in Table E.3.2-1. In each case, the calculated emission rate is greater than the TEV, indicated by a TRUE in the results column. The site boundary carcinogenic chemical concentrations from the Y-12 Steam Plant are presented in Table E.3.2-2 and are further evaluated in the Human Health and Worker Safety analysis of this SWEIS (Appendix D).

Carcinogenic Chemical Screening - Y-12 Site Operations

Sixteen carcinogenic HAPs from Y-12 Site operations are identified and presented in Table E.3.2-3. Carcinogenic chemical emissions from Y-12 Site operations were evaluated using the same screening criteria as that used for the Y-12 Steam Plant carcinogenic chemical screening. One carcinogenic HAP from Y-12 Site operations exceeded the respective TEV indicated by TRUE in the results column.

TABLE E.3.2–1.—*Y-12 Steam Plant Carcinogenic Screening Results*

Building Number	CAS Number	Chemical	Emissions (gms/yr)	Emissions (gms/sec)	10^{-8} Risk Level (Fg/m^3)	TEV (g/s)	Result
Y-9401-3	7440-38-2	Arsenic	1.12 x 10^{+4}	3.55 x 10^{-4}	2.33 x 10^{-6}	2.43 x 10^{-5}	TRUE
Y-9401-3	7440-41-7	Beryllium	1.68 x 10^{+3}	5.33 x 10^{-4}	4.17 x 10^{-6}	4.35 x 10^{-5}	TRUE
Y-9401-3	7440-43-9	Cadmium	1.45 x 10^{+3}	4.60 x 10^{-4}	5.56 x 10^{-6}	5.80 x 10^{-5}	FALSE
Y-9401-3	7440-02-0	Nickel	2.68 x 10^{+4}	8.50 x 10^{-3}	4.17 x 10^{-5}	4.35 x 10^{-4}	TRUE

Source: LMES 1997.

TABLE E.3.2–2.—*Y-12 Steam Plant Maximum Boundary Carcinogenic Chemical Concentrations*

Building Number	CAS Number	Chemical	Emissions (gms/yr)	Emissions (gms/sec)	Maximum Boundary Concentration (Fg/m^3)
Y-9401-3	7440-38-2	Arsenic	$1.12 \times 10^{+4}$	3.55×10^{-4}	3.40×10^{-5}
Y-9401-3	7440-41-7	Beryllium	$1.68 \times 10^{+3}$	5.33×10^{-4}	5.10×10^{-5}
Y-9401-3	7440-02-0	Nickel	$2.68 \times 10^{+4}$	8.50×10^{-3}	8.14×10^{-4}

Source: LMES 1997.

TABLE E.3.2–3.—*Y-12 Site Screening Evaluation of Noncarcinogenic Chemical Emissions*

CAS Number	Chemical	Total Kilograms	Emissions (g/yr)	ER (g/s)	Unit Risk Factor	10^{-8} Risk Level (Fg/m^3)	TEV (g/s)	Result
000107-06-2	1,2-Dichloroethane	0.0036	3.60	5.00×10^{-7}	2.60×10^{-5}	3.85×10^{-4}	9.86×10^{-4}	FALSE
000088-06-2	2,4,6-Trichlorophenol	0.019	19.0	2.64×10^{-6}	3.10×10^{-6}	3.23×10^{-3}	8.27×10^{-3}	FALSE
000107-13-1	Acrylonitrile	0.0001	0.10	1.39×10^{-8}	6.80×10^{-5}	1.47×10^{-4}	3.77×10^{-4}	
007440-38-2	Arsenic & Compounds	0.0007	7.00×10^{-1}	9.72×10^{-8}	4.30×10^{-3}	2.33×10^{-6}	5.96×10^{-6}	FALSE
000071-43-2	Benzene	1.6759	1.68×10^{3}	2.33×10^{-4}	7.80×10^{-6}	1.28×10^{-3}	3.29×10^{-3}	FALSE
000092-87-5	Benzidine	0.0002	2.00×10^{-1}	2.78×10^{-8}	6.70×10^{-2}	1.49×10^{-7}	3.83×10^{-7}	FALSE
007440-41-7	Beryllium & Compounds	0.001	1.00	1.39×10^{-7}	2.40×10^{-3}	4.17×10^{-6}	1.07×10^{-5}	FALSE
007440-43-9	Cadmium & Compounds	0.2613	2.61×10^{2}	3.63×10^{-5}	1.80×10^{-3}	5.56×10^{-6}	1.42×10^{-5}	TRUE
000056-23-5	Carbon Tetrachloride	0.047	47.0	6.53×10^{-6}	1.50×10^{-5}	6.67×10^{-4}	1.71×10^{-3}	FALSE
000067-66-3	Chloroform	0.7419	7.42×10^{2}	1.03×10^{-4}	2.30×10^{-5}	4.35×10^{-4}	1.11×10^{-3}	FALSE
000106-89-8	Epichlorohydrin	10	1.00×10^{4}	1.39×10^{-3}	1.20×10^{-6}	8.33×10^{-3}	2.14×10^{-2}	FALSE
000050-00-0	Formaldehyde	2.924	2.92×10^{3}	4.06×10^{-4}	1.30×10^{-5}	7.69×10^{-4}	1.97×10^{-3}	FALSE
000118-74-1	Hexachlorobenzene	0.0272	27.2	3.78×10^{-6}	4.60×10^{-4}	2.17×10^{-5}	5.57×10^{-5}	FALSE
000067-72-1	Hexachloroethane	0.0272	27.2	3.78×10^{-6}	4.00×10^{-6}	2.50×10^{-3}	6.41×10^{-3}	FALSE
000062-75-9	N-nitrosodimethylamine	0.0045	4.50	6.25×10^{-7}	1.40×10^{-2}	7.14×10^{-7}	1.83×10^{-6}	FALSE
007440-02-0	Nickel Compounds	0.0001	1.00×10^{-1}	1.39×10^{-8}	2.40×10^{-4}	4.17×10^{-5}	1.07×10^{-4}	FALSE

Note: CAS - Chemical Abstracts Service Registry Number; ER - Emission Rate; OEL - A time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect; TRUE - Emission rate exceeds the TEV; FALSE - Emission rate is less than the TEV.
Source: MMES 1998, ACGIH 1997.

TABLE E.3.2–4.—*Maximum Boundary and On-site Carcinogenic Chemical Concentrations from Y-12 Site Operations*

CAS Nu	Chemical	Total Kilograms	Emissions (g/yr)	ER (g/s)	Maximum Boundary Concentration [a] (Fg/m^3)	Maximum On-Site Concentration[b] (Fg/m^3)
007440-43-9	Cadmium & Compounds	0.2613	2.61 x 10^{2}	3.63 x 10^{-5}	1.42 x 10^{-5}	2.52 x 10^{-2}

[a]Anual average concentrations.
[b]8-hour average concentrations.
Note: CAS - Chemical Abstracts Service Registry Number; ER - Emission Rate.
Source: LMES 1997.

E.4 RADIOLOGICAL AIR QUALITY

E.4.1 Maximally Exposed Individual and Collective Population

E.4.1.1 *Radiological Assessment Methodology*

This section presents detailed information on the methodology and data used to assess the potential radiological doses associated with emissions of radionuclides from routine operations of current missions and proposed new facilities at Y-12. The radiological doses from routine operations were assessed for the maximally exposed individual (MEI) and the population within 80 km (50 mi) of Y-12. The radiological impacts of the operations for Alternative 1A (No Action - Status Quo Alternative) and Alternative 1B (No Action - Planning Basis Operations Alternative) were calculated by using the CAP-88 (CAA Assessment Package - 1988) computer model which is used for demonstrating National Emissions Standards for Hazardous Air Pollutants (NESHAP) compliance under 40 CFR 61, NESHAP. The CAP-88 model, input parameters, and results are described below.

E.4.1.2 *Model Description*

The CAP-88 computer model (DOE 1997) is a set of computer programs, databases, and associated utility programs for estimating dose and risk from radionuclide air emissions for purposes of demonstrating compliance under *National Emissions Standards for Hazardous Air Pollutants: Radionuclides* (Rad NESHAP) (40 CFR 61). CAP-88 contains modified versions of AIRDOS-EPA and DARTAB computer codes and the ALLRAD88 radionuclide data file. The AIRDOS-EPA computer code uses a steady-state Gaussian plume atmospheric dispersion model to calculate environmental concentrations of radionuclides. CAP-88 also uses Nuclear Regulatory Commission (NRC) Regulatory Guide 1.109 (NRC 1977) food chain models to calculate radionuclide concentrations in foodstuffs (vegetables, meat, and milk) and subsequent intake by humans (DOE 1999).

Dose conversion factors are derived from data generated by the DARTAB model, an integral part of CAP-88, which follows the methodology on the International Commission for Radiation Protection (ICRP 1991). The effective dose equivalent (EDE) is calculated using the weighting factors given in ICRP Publication 26. Risks are based on lifetime risks from lifetime exposures, with a nominal value of 4 x 10^{-4} cancers/rem.

CAP-88 can model as many as 36 radionuclides released from up to six emission sources. The sources may be elevated stacks or uniform area sources. Receptors are located within a circular grid of distances and directions for a radius of 80 km (50 mi) around the emission point. The CAP-88-PC model is the PC version of the model CAP-88, which is run on a main frame computer.

E.4.1.3 *Data*

Source Parameters. Facility releases occur from stack exhausts or vents and are modeled as point sources. For purposes of this analysis, all the various major and minor emission sources at Y-12 can be grouped into three emission points:

- Monitored stacks
- Minor processes
- Lab hoods

For releases from these sources, the CAP-88-PC model calculates a momentum-type plume rise. Plume rise is calculated from the stack diameter and exhaust velocity. Table E.4.1–1 presents the emission source parameters assumed for the modeling provided from the Y-12 Site. The Y-12 emission points are located approximately at the center of Building 9212.

TABLE E.4.1–1.—*Source Characteristics Used in the Radiological Air Dispersion Modeling*

Source	Source Type	Release Height (m)	Stack Diameter (m)	Exhaust Velocity (m/s)	Release Temperature (EC)	Plume Rise
Monitored Stacks	Point	20	NA	NA	Ambient	Momentum
Minor Processes	Point	20	NA	NA	Ambient	Momentum
Lab Hoods	Point	20	NA	NA	Ambient	Momentum

Note: NA - Not Applicable.
Source: DOE 1999.

Emissions Data. Emissions from Y-12 occur as a result of plant production, maintenance, and waste management activities. The major dose contributing radionuclides emitted from Y-12 consist of ^{234}U, ^{235}U, ^{236}U, and ^{238}U, all of which are emitted as particulates. The particle size and solubility class for the uranium emissions are based on review of the operations and processes served by the exhaust systems to determine the quantity of uranium handled in the operation or process, the physical form of the uranium, and the nature of the operation or process (Swanks 1999).

The emission data for the calendar year 1998 (Swanks 1999) as reported in the NESHAP 1998 is used as Alternative 1A (No Action - Status Quo Alternative) for Y-12. Under Alternative 1B (No Action - Planning Basis Operations Alternative), the annual enriched uranium emissions and other effluents for the period 2001–2010 were assumed to be 65 percent of the 1987 levels (Garber 2000).

TABLE E.4.1–2.—*Radiological Air Emissions, 1987*

Radionuclide	Quantity (Ci/yr)
^{234}U	1.10×10^{-1}
^{235}U	4.30×10^{-3}
^{238}U	2.54×10^{-2}
Total	**0.14 Ci**

Source: MMES 1988.

TABLE E.4.1–3.—*Modeled Radionuclide Emissions for Alternative 1A (No Action - Status Quo Alternative) and Alternative 1B (No Action - Planning Basis Operations Alternative)*

Radionuclide	Solubility	AMAD[a]	Alternative 1A (No Action - Status Quo Alternative) [b](1998)(Ci/Yr)	Alternative 1B (No Action - Planning Basis Operations Alternative)[c] (Ci/Yr)
Am-241	W	1	6.00×10^{-9}	NDA
Am-243	W	1	1.40×10^{-8}	NDA
				NDA
Co-57	Y	1	6.95×10^{-10}	NDA
Co-58	Y	1	6.20×10^{-12}	NDA
Co-60	Y	1	9.29×10^{-7}	NDA
Cs-134	D	1	5.56×10^{-8}	NDA
Cs-137	D	1	6.25×10^{-6}	NDA
Eu-152	W	1	2.63×10^{-8}	NDA
Eu-154	W	1	3.33×10^{-8}	NDA
Eu-155	W	1	9.52×10^{-7}	NDA
H-3			3.41	NDA
I-125	D	1	1.50×10^{-7}	NDA
Np-237	W	1	3.71×10^{-8}	NDA
Np-239	W	1	1.00×10^{-8}	NDA
P-32	D	1	4.50×10^{-7}	NDA
Pb-212	D	1	5.41×10^{-7}	NDA
Pu-236	W	1	5.00×10^{-10}	NDA
Pu-238	W	1	5.33×10^{-8}	NDA
Pu-239	W	1	4.32×10^{-8}	NDA
Pu-240	W	1	2.00×10^{-9}	NDA
Pu-242	W	1	2.16×10^{-8}	NDA
Ra-226	W	1	4.00×10^{-9}	NDA
Ra-228	W	1	4.00×10^{-9}	NDA
Sr-90	D	1	2.16×10^{-6}	NDA
Tc-99	W	1	1.01×10^{-3}	NDA
Th-228	Y	1	1.01×10^{-9}	NDA
Th-229	Y	1	9.63×10^{-9}	NDA
Th-230	Y	1	2.25×10^{-08}	NDA
Th-232	Y	1	1.58×10^{-8}	NDA
U-232	Y	1	1.10×10^{-8}	NDA
U-233	Y	1	1.04×10^{-5}	NDA
U-234	Y	1	1.22×10^{-2}	7.15×10^{-2}
U-234	W	1	4.70×10^{-4}	NDA
U-234	D	1	8.36×10^{-4}	NDA
U-235	Y	1	4.10×10^{-4}	2.795×10^{-3}
U-235	W	1	1.50×10^{-5}	NDA
U-235	D	1	2.62×10^{-5}	NDA
U-236	Y	1	4.43×10^{-5}	NDA
U-236	W	1	2.00×10^{-6}	NDA
U-236	D	1	3.53×10^{-6}	NDA
U-238	Y	1	3.25×10^{-3}	1.651×10^{-2}
U-238	W	1	1.30×10^{-7}	NDA
U-238	D	1	2.32×10^{-7}	NDA

[a] Activity Medium Aerodynamic Diameter.
[b] DOE 1999.
[c] MMES 1988.
Note: NDA = no data available.

A total of 0.14 Ci of uranium was released from Y-12 during 1987 (Table E.4.1–2). Therefore, a total of 0.0908 Ci of uranium is assumed to be released each year from Y-12 under No Action - Planning Basis Operations Alternative for the period 2001–2010. The released uranium was assumed to be completely insoluble (Y solubility). The isotopic composition of the radionuclide emissions for No Action - Status Quo Alternative and No Action - Planning Basis Operations Alternative are presented in Table E.4.1–3.

The emission data for Alternative 1B (No Action - Planning Basis Operations Alternative) is assumed to include all the emissions from the storage of highly enriched uranium (HEU) in existing facilities. The emissions for the HEU storage mission action alternatives at Y-12 (i.e., construction of a new HEU Materials Facility at one of the two potential sites or construction of an upgrade to the existing Building 9215) are expected to be at or below No Action - Status Quo Alternative levels. This is due to administrative and engineered controls such as multiple levels of high-efficiency particulate air filters at new facilities. The proposed Special Materials Complex would not contribute to the radioactive emissions at Y-12 as the facilities do not handle radioactive materials.

Meteorological Data. On-site meteorological data recorded at the MT6 meteorological tower were used as input into the CAP-88-PC model. Table E.4.1–4 shows the key meteorological data that were used in assessing radiation doses for No Action - Status Quo Alternative. Meteorological data were derived from data collected during 1998 at the 60-m (197-ft) height on tower MT6. The data consist of frequency distribution of wind direction, wind speed class, and atmospheric stability category.

TABLE E.4.1–4.—*Meteorological Data for Tower MT6 (No Action - Status Quo Alternative)*

Data collection height	60 m
Minimum monthly data collection	90.7%
Precipitation	140.7 cm/yr
Average air temperature	15.9 EC
Average mixing layer height	1,000

Source: DOE 1999.

For modeling of Alternative 1B (No Action - Planning Basis Operations Alternative), a 10-year average (1990-1999) of the meteorological data was used (O'Donnell 1999). The average temperature is 14.6EC and the average rainfall (30-year average for ORR) is 137 cm/yr (Sharp, 2000).

Demographic Data. Demographic data include population, numbers of beef and dairy cattle, and the area of food crop harvesting. The estimated population surrounding the Y-12 Plant was based on 1990 population data. Table E.4.1–5 presents the population distribution used in the analysis.

All food products consumed by exposed persons within the Y-12 region are assumed to come from the local area or within an 80-km (50-mi) radius. The distribution of foodstuff presented in Table E.4.1–6 indicates the agricultural production or food consumption data used as input into the model. The model is run assuming that each person remains outside the house, unprotected during the entire year, and acquires food according to the rural pattern defined in NESHAP background documents.

TABLE E.4.1–5.—*Population Distribution Within 80 km (50 mi) of the Y-12*

	Distance (miles)										
Direction	**0-1**	**1-2**	**2-3**	**3-4**	**4-5**	**5-10**	**10-20**	**20-30**	**30-40**	**40-50**	**Total**
N	0	87	190	1,71	512	2,508	735	2,284	2,608	8,167	18,809
NNW	0	311	1,119	671	320	1,863	950	998	9,195	5,234	20,661
NW	0	15	17	277	273	2,102	4,316	2,174	2,848	8,426	20,448
WNW	0	3	0	222	182	899	3,408	1,540	2,483	4,821	13,558
W	0	0	0	0	32	1,533	9,435	2,006	14,60	12,382	40,010
WSW	0	0	0	0	0	1,529	11,953	8,875	5,521	4,930	32,808
SW	0	0	0	0	4	1,119	2,941	3,760	6,478	11,362	25,664
SSW	0	0	0	6	60	998	3,309	10,266	22,56	14,837	52,041
S	0	0	0	0	97	2,452	10,820	7,807	9,040	3,876	34,092
SSE	0	0	0	0	2	2,920	8,323	4,949	1,787	1,347	19,328
SE	0	0	0	15	222	4,407	9,524	29,185	1,198	815	45,366
ESE	0	0	0	0	168	8,028	31,387	36,292	8,771	11,975	96,621
E	0	0	0	0	7	3,321	83,371	103,179	22,90	21,722	234,501
ENE	0	0	0	0	0	2,318	30,485	54,882	16,29	18,052	122,031
NE	0	0	0	693	1,047	13,639	15,953	8,673	5,331	6,763	52,099
NNE	0	1	17	890	3,221	5,159	5,761	13,652	15,76	7,048	51,509

Source: O'Donnell 1999.

TABLE E.4.1–6.—*Food Consumption Data Within the Y-12 Region*

Foodstuff	**Fraction grown**		
	In local area	**Within 50-mile radius**	**Beyond 50-mile radius**
Vegetable and produce	0.70	0.30	0.00
Meat	0.40	0.60	0.00
Milk	0.44	0.56	0.00

Source: Swanks 1999.

E.4.1.4 *Results*

Calculated EDEs from radionuclides emitted to the atmosphere from different sources within Y-12 are listed in Tables E.4.1–7 and E.4.1–8. The total effective dose equivalent (TEDE) received by the hypothetical MEI for Y-12 was calculated as 0.53 mrem/yr for Alternative 1A (No Action - Status Quo Alternative) and 4.5 mrem/yr for Alternative 1B (No Action - Planning Basis Operations Alternative). These doses are well below the NESHAP standard of 10 mrem/yr. The MEI is located 1,080 m (3,543 ft) north-northeast of the Y-12 release point. The collective EDE to the population residing within 80 km (50 mi) of Y-12 for No Action - Status Quo Alternative was calculated as 4.3 person-rem and for the No Action - Planning Basis Operations Alternative, 33.7 person-rem.

TABLE E.4.1–7.—*Total Effective Dose Equivalents for the Maximally Exposed Individuals at Y-12 for No Action - Status Quo Alternative and No Action -Planning Basis Operations Alternative*

Source	Alternative 1A (No Action - Status Quo Alternative)[a] (mrem/yr)	Alternative 1B (No Action - Planing Basis Operations Alternative) (mrem/yr)
Y-12 Plant	0.53	4.5

[a] Source: DOE 1999.

TABLE E.4.1–8—*Effective Dose Equivalents for the Collective Population within 80 km (50 mi) of Y-12 for No Action - Status Quo Alternative and No Action -Planning Basis Operations Alternative*

Source	Alternative 1A (No Action - Status Quo Alternative)[a] (person-rem/yr)	Alternative 1B (No Action - Planing Basis Operations Alternative) (person-rem/yr)
Y-12 Plant	4.3	33.7

[a] Source: DOE 1999.

E.4.2 Workers

Introduction

This section presents the radiological doses associated with the workers for various operations at Y-12. For the analysis presented in this SWEIS the radiation or involved workers (Rad Workers) are either LMES employees or subcontractors whose job assignments place them in proximity to radiation-producing equipment and/or radioactive materials. These workers are trained for unescorted access to radiological areas and may also be trained Rad workers from another U.S. Department of Energy (DOE) site. These workers have the potential to receive an annual EDE of more than 100 mrem/year. All trained Rad workers wear dosimeters which measures the individual's external dose information. The nonradiation or noninvolved workers (Non-Rad workers) may be either LMES employees or subcontractors who are not currently trained as Rad workers but whose job assignment may require their occasional presence within a radiologically controlled area with an escort. They may be exposed to transient radiation fields as they pass by or through a particular area, but their job assignments are such that annual dose equivalents in excess of 100 mrem are unlikely. These workers are issued a dosimeter only when they are required to wear one to enter a posted area. Figure E.4.2–1 shows the major radiological emissions area at Y-12 associated with the various major Defense Programs (DP) Mission operations/facilities.

Doses

The average individual Y-12 worker dose (Rad and Non-Rad) and the average individual Y-12 Rad worker dose for 1989 (the representative analyses year) and 1998 (No Action - Status Quo Alternative) are presented in Table E.4.2–1. The average TEDE's for Rad workers for various operations within Y-12 are presented in Table E.4.2–2. The worker doses are recorded using dosimeters. Bioassay monitoring performed by Y-12 provide the individual's internal dose information. The information from dosimeters and bioassays is totaled annually to obtain TEDE for each worker.

Source: Tetra Tech, Inc.

FIGURE E.4.2–1.—*Y-12 Plant Major Radiological Emissions Area.*

TABLE E.4.2–1.—*Radiation Dose Data for Y-12 Employees (All Y-12 Workers and Y-12 Rad Workers)*

Year	No of Monitored Y-12 Workers	No. of Rad Workers	Average Individual Y-12 Worker Dose (TEDE)	Average Individual Y-12 Rad Worker Dose (TEDE)
1989	9241	2470	11.6	33.6
1998	5128	3563	8.0	11.4

Source: Y-12 1999.

Rad Workers

The average TEDE in 1998 (No Action - Status Quo Alternative) presented in Table E.4.2–2 for the Rad workers for each operation are used to calculate the cumulative dose for the Rad workers present at each operation area. The average individual Y-12 Rad worker dose in 1998 (No Action - Status Quo Alternative) and 1989 (No Action - Planning Basis Operations Alternative, representative analysis year) presented in Table E.4.2–1 for the Y-12 Site are used to calculate the cumulative doses for the Rad workers at Y-12 for Alternative 1A (No Action - Status Quo Alternative) and Alternative 1B (No Action - Planning Basis Operations Alternative). The average individual Y-12 Rad worker dose in 1989 is used for the No Action - Planning Basis Operations Alternative instead of 1987 data to calculate the cumulative dose because the method of measuring the TEDEs changed in 1989 (similar to 1998, No Action - Status Quo Alternative) as compared to the year 1987. In addition, the restructuring of operations in 1989 made tracking the 1987 dose received by workers difficult.

Y-12 Workers (Rad and Non-Rad)

The average individual Y-12 worker dose in 1998 (No Action - Status Quo Alternative) and 1989 (No Action-Planning Basis Operations Alternative, representative analysis year) presented in Table E.4.2–1 for the Y-12 Site are used to calculate the cumulative dose for all the workers (Rad and Non-Rad) in various operations at Y-12. The average individual Y-12 worker dose in 1989 is used for the Alternative 1B (No Action-Planning Basis Operations Alternative) instead of 1987 to calculate the cumulative dose because the method of measuring the TEDEs changed in 1989 (similar to 1998, No Action - Status Quo Alternative) as compared to the year 1987. The average individual Y-12 worker dose is used for the worker doses for various operations since the total dose for all the workers are not available in these operations.

Summary

The number of workers for each major DP operation are shown in Table E.4.2–3. Table E.4.2–4 presents the summary of the radiological doses for Rad and Non-Rad workers for Alternative 1A (No Action - Status Quo Alternative) and Alternative 1B (No Action - Planning Basis Operations Alternative) for each operation and Y-12 as a whole.

E.4.3 HEU Storage Mission

E.4.3.1 *Alternative 1A (No Action - Status Quo Alternative) and Alternative 1B (No Action - Planning Basis Operations Alternative)*

The collective dose to the workers under the No Action Alternatives for the existing HEU Storage Mission is 0.74 person-rem (35 workers x 21 mrem/year).

E.4.3.2 *HEU Materials Facility*

The collective dose to workers due to initial relocation operations including material handling is 5.25 person-rem (35 workers x 150 mrem/yr) (LMES 2000a, LMES 2000b).

The collective dose to the workers due to the transportation of HEU is 0.075 person-rem and is addressed in Chapter 5 (Environmental Consequences) of this SWEIS. Finally, the collective dose to the workers during normal operations due to the storage of the HEU in the new HEU Materials Facility is 0.29 person-rem (14 involved workers x 21 mrem/yr), a decrease of 61 percent from the No Action Alternatives.

TABLE E.4.2–2.—*Total Effective Dose Equivalents for Workers for Various Operations at Y-12*

Division Acronym	Division Number/ Name Used	Collective TEDE (person - mrem)			Average TEDE (mrem)			Maximum TEDE (mrem)		
		1997	1998	1999 (through 6/30)	1997	1998	1999 (through 6/30)	1997	1998	1999 (through 6/30)
EUO	37 - Enriched Uranium Ops	4347	29,440	16,260	12.28	85.83	57.65	847	1295	829
DUO	24 - Depleted Uranium Ops	626	2458	15,236	2.7	10.92	52	60	108	1259
DSO	01-Disassembly Ops.	1725	1956	4042	9.48	10.63	20.51	92	131	686
FP	54 - Fire Protection	0	32	28	0	0.39	0.27	0	13	11
ACO	65 - Analytical Chemistry Org.	12	193	358	0.06	0.95	1.75	6	39	0.93
PCO	55 - Product Certification	74	482	882	0.6	3.2	5.58	20	113	82
MCO	08 - Material Control	*No data available*								
RCO	56-RADCON	1451	2871	3538	8.44	17.83	23.9	555	674	382
BOP	Balance of Plant	808	1580	1905	0.53	0.94	1.4	42	159	679
GMO	03 - General Manufacturing Org.	18	81	39	0.56	2.19	1.56	13	43	38
SMS	58 - Y-12 Plant Managers	0	11	13	0	0.55	0.76	0	11	9
SMO	18 - Special Materials Organization	15	14	11	0.27	0.25	0.16	15	4	3
FMO	35 - Facilities Maintenance Org.	1250	1756	942	1.56	2.19	1.19	70	96	69
DEV	15 - Development	99	206	86	0.85	1.76	0.83	33	41	13

Source: Oxley 2000.

TABLE E.4.2–3.—*Number of Involved (Rad) and Non-Involved (Non-Rad)Workers for Major Y-12 Defense Programs Production Operations*

Operation	Total Workers		Radiological Workers		Non-Radiological Workers	
	No Action - Status Quo Alternative	No Action - Planning Basis Operations Alternative	No Action - Status Quo Alternative	No Action - Planning Basis Operations Alternative	No Action - Status Quo Alternative	No Action - Planning Basis Operations Alternative
Enriched Uranium	393	492	192	240	201	252
Depleted Uranium	223	223	220	220	3	3
Assembly/Disassembly	160	160	150	150	10	10
Product Certification	150	158	125	132	25	26
Analytical Chemistry	163	180	126	143	37	37
Lithium	36	53	0	0	36	53
Special Materials Complex	45	45	0	0	45	45
Y-12 Plant	5128	5128	3563	3563	1565	1565

Source: Garber 2000.

TABLE E.4.2–4.—*Summary of the Radiological Doses for Rad and Non-Rad Workers at Y-12 for Major DP Production Operations Under the No Action - Status Quo Alternative and the No Action - Planning Basis Operations Alternative*

Facility	Rad Workers						All Workers (Rad and Non-Rad)					
	No Action - Status Quo Alternative			No Action - Planning Basis Operations Alternative			No Action - Status Quo Alternative			No Action - Planning Basis Operations Alternative		
	Number of Workers	Individual Worker Doses (mrem/yr)	Collective Population Doses (person-rem)	Number of Workers	Individual Worker Doses (mrem/yr)	Collective Population Doses (person-rem)	Number of Workers	Individual Worker Doses (mrem/yr)	Collective Population Doses (person-rem)	Number of Workers	Individual Worker Doses (mrem/yr)	Collective Population Doses (person-rem)
Enriched Uranium	192	85.83	16.48	240	NA	NA	393	8	3.14	492	11.6	5.71
Depleted Uranium	220	10.92	2.40	220	NA	NA	223	8	1.78	223	11.6	2.59
Assembly/ Disassembly Quality Evaluation	150	10.63	1.59	150	NA	NA	160	8	1.28	160	11.6	1.86
Product Certification	125	3.2	0.4	132	NA	NA	150	8	1.2	158	11.6	1.83
Analytical Chemistry	126	0.95	0.12	143	NA	NA	163	8	1.30	180	11.6	2.09
Y-12 Plant	3563	11.4	40.62	3563	33.6	119.72	5128	8	41.02	5128	11.6	59.48

Note: According to the Y-12 DRS database, the collective population dose to the Y-12 Rad workers for No Action - Status Quo Alternative is 40.61 person-rem and collective population dose for all Y-12 workers for No Action - Status Quo Alternative is 41.24 person-rem.

References Appendix E

40 CFR 50	U.S. Environmental Protection Agency (EPA), "Protection of the Environment: National Ambient Air Quality Standards (NAAQS), National Primary and Secondary Ambient Air Quality Standards," *Code of Federal Regulations:* Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC, July 1998.
40 CFR 51	EPA, "Protection of the Environment: Guideline on Air Quality Models, Requirements for Preparation, Adoption, and Submittal of Implementation Plans," *Code of Federal Regulations,* Office of the Federal Register, National Archives and Records Administration, Washington, DC, July, 1998.
40 CFR 61	EPA "Protection of the Environment: National Emission Standards for Hazardous Air Pollutants," *Code of Federal Regulations*, Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC, July 1, 1995.
42 U.S.C.§7401	"Programs and activities, Air Quality and Emissions Limitations", Title 42, Public Health and Welfare; Chapter 85, Air Pollution Prevention and Control, *United States Code*, Washington, DC, as amended, January 5, 1999.
ACGIH 1997	American Conference of Governmental Industrial Hygienists (ACGIH), *Guide to Occupational Exposure Values-1997,* ISBN: 1-882417-20-8, Cincinnati, OH, 1997.
DOE 1997	U.S. Department of Energy (DOE), *CAP-88-PC Version 2.0 User's Guide*, ER-8/GTN, U.S. Department of Energy, Germantown, MD, June, 1997.
DOE 1999	DOE, *Oak Ridge Reservation Annual Site Environmental Report for 1998*, DOE/ORO/2091, prepared by Lockheed Martin Energy Research Corporation, Inc. Lockheed Martin Energy Systems, Inc., and Bechtel Jacobs Company for the U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, TN, December 1999.
EPA 1995	EPA, *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Fifth Edition*, AP-42, Office of Air Quality Planning and Standards, Research Triangle Park, NC, January, 1995.
EPA 1999	EPA, *Integrated Risk Information System* (IRIS), Inhalation Reference Concentrations, 1999.
Garber 2000	Garber, J., B. McElroy, and M. Reichert, *Recommended Baseline for Use in the Y-12 Site Wide Environmental Impact Statement*, transmittal to I. Shelton and T. Smith at Lockheed Martin Energy Systems, Inc. Oak Ridge, TN, February 18, 2000.
ICRP 1991	*ICRP 1990 Recommendations of the International Commission on Radiological Protection.* Publication 60, Volume 21, No. 1-3, Annals of the ICRP, Pergamon Press, New York, NY 1991.

LMES 1997 — Lockheed Martin Energy Systems, Inc. (LMES), *Major Source Operating Permit Applications for the U.S. Department of Energy, Oak Ridge, Y-12 Plant, Volume 2, Applications for Emission Sources in Buildings 9201-1, 9201-1W, 9401-2, 9401-3, 9404-9, 9720-32, 9738, 9767-4, 9767-13, 9811-5, 9815*, Air Compliance Program, Environmental Compliance Organization Y-12 Plant, July 1997.

LMES 2000a — LMES, *Responses to data requests for the Highly Enriched Storage Mission Alternatives for the Y-12 Site-Wide Impact Statement*, transmittal from I. Shelton, Lockheed Martin Energy Systems, Y-12 Plant, to F. Jackson of Tetra Tech, Inc., Oak Ridge, TN, March 2000.

LMES 2000b — LMES, *Responses to questions on number of workers (total, RAD, etc.)* transmitted by various operations emails from I. Shelton, Lockheed Martin Energy Systems, Inc., Y-12 Plant, to F. Jackson, Tetra Tech, Inc., Oak Ridge, TN, March 2000.

MMES 1988 — Rogers, J. G., K. L. Daniels, S. T. Goodpasture, and C. W. Kimbrough, *Environmental Surveillance of the U.S. Department of Energy Oak Ridge Reservation and Surrounding Environ During 1987*, prepared by Martin Marietta Energy Systems, Inc. (MMES) for the U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, TN, April 1988.

MMES 1998 — Martin Marietta Energy Systems (MMES), *Hazardous Material Information System* (HMIS), 1998.

NRC 1977 — U.S. Nuclear Regulatory Commission (NRC), *Regulatory Guide 1.109*, U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulations, Washington, DC, October 1997.

O'Donnell 1999 — O'Donnell, F., *10 Year Meteorological Data for the Y-12 Plant*, transmittal from Oak Ridge National Laboratory to P. K. Juriasingani, Tetra Tech NUS, Oak Ridge, TN, September 7, 1999.

Oxley 2000 — Oxley, L., *TEDF data by organization* email from Laura Oxley Y-12 Plant U.S. Department of Energy, to P. K. Juriasingani, Tetra Tech NUS, Oak Ridge, TN, March 2000.

Sharp 2000 — Sharp, R. D., *Requested Information*, transmittal from Oak Ridge National Laboratory to P. K. Juriasingani, Tetra Tech NUS, March 14, 2000.

Shelton 1999 — Shelton, I., *Communications regarding meteorological towers,* transmittal from Lockheed Martin Energy Systems, Inc. to F. Jackson, Tetra Tech, Inc., Oak Ridge, TN, July 1999.

Smith 1999 — Smith, T. E., *Additional Modernization Alternative Information*, memoranda from Lockheed Martin Energy Systems, Inc. to F. Jackson, Tetra Tech, Inc., Oak Ridge, TN, August 16, 1999.

Swanks 1999 — Swanks, J. H., *Air Emissions Annual Report for the Oak Ridge Reservation Radionuclide National Emission Standards for Hazardous Air Pollutants, Calendar Year 1998*, transmittal from Oak Ridge National Laboratory to Peter Gross, U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, TN, June 18, 1999.

TDEC 1999 — TDEC, *Rules of Tennessee Department of Environment and Conservation, Chapter 1200-3-1 through Chapter 1200-3-34,* Bureau of Environment, Division of Air Pollution Control, April (revised) 1999.

Y-12 1999 — LMES, *Radiation Dose Trends by Y-12 Workers*, Y-12 DRS Database, transmittal from Rhoda Bogard to Lori Moore, Y-12 Plant, Department of Energy, Oak Ridge, TN, August 1999.